

A light blue, stylized cloud with a black outline is positioned at the top center. Several thin black lines representing rain fall from the bottom of the cloud. Each line ends with a small, light blue oval representing a raindrop. There are six raindrops in total, three on the left side and three on the right side of the central text.

Monitoring Program for Mercury in Precipitation in Indiana

MONITORING PROGRAM FOR MERCURY IN PRECIPITATION IN INDIANA

Data Summary for Fall 2000 through Fall 2002

(prepared January 2003)

Introduction

The data in this summary for Indiana are presented in eight seasonal groups (fall 2000 through fall 2002) and in composite for 2001. Three monitoring stations for mercury in precipitation in Indiana were placed in operation during fall 2000. The stations at the Dunes National Lakeshore and Huntington Reservoir collected data during November and December 2000. The station at the Bloomington Airport collected data during late December 2000. The weekly data for fall 2000 have been finalized and are posted on the National Atmospheric Deposition Network (NADP) website [<http://nadp.sws.uiuc.edu/mdn/in.asp>]. All four Indiana monitoring stations collected data during 2001 and data are presented in four seasonal groups—winter 2001 (January through March), spring 2001 (April through June), summer 2001 (July through September), and fall 2001 (October through December). The weekly data for all of 2001 have been finalized and are posted on the NADP website. All four Indiana monitoring stations collected data during 2002 and data are presented in three seasonal groups—winter 2002 (January through March), spring 2002 (April through June), and fall 2002 (July through September). The weekly data for winter 2002 have been finalized and are posted on the NADP website. The spring and summer 2002 data are preliminary until final weekly data are posted on the NADP website, which is planned for early 2003. This data summary is planned to be updated periodically during 2003.

Terms, Units, and Calculations

This summary quantifies precipitation, mercury concentrations, and mercury deposition. The total amount of **precipitation** (in inches) was recorded by the rain gage at the monitoring station. Rain, snow, and mixtures of liquid and frozen precipitation were included. The **concentrations** (mass per volume of water) of total mercury and methylmercury were summarized from laboratory analysis of the weekly precipitation samples in the automated collector at the monitoring station. Total mercury includes inorganic and organic mercury. Methylmercury is the form of organic mercury reported as part of the total mercury. Methylmercury was analyzed separately because it is the form of mercury that accumulates in the aquatic food web. Concentration units are nanograms per liter (equivalent to one-thousandth microgram per liter and approximately one part per trillion). The *median concentration* is the value that separates the rank-ordered data into two parts—half of the concentrations were greater than the median and half of the concentrations were less than the median. The *volume-weighted mean concentration* is a sum of the adjusted weekly concentrations, based on the precipitation. To obtain the volume-weighted mean concentration, the weekly sample concentration was adjusted (multiplied) by the ratio of that week's precipitation to the total precipitation for the season. The **weekly deposition** (mass per unit area) is the amount of total mercury or methylmercury that theoretically fell to the ground in precipitation, based on the sample in the automated collector. Deposition was calculated by multiplying the weekly sample concentration by the adjusted weekly precipitation and converting to units of nanograms per square meter. Weekly precipitation was adjusted (multiplied) by the ratio of the area of precipitation gage opening to the area of the automated collector opening. The *sum of the weekly deposition* was calculated for each season and in composite for 2001. *Deposition per inch of precipitation* was calculated as the sum of the weekly deposition divided by total precipitation.

Seasonal Data for 2000 and 2001

The following five tables present seasonal values for: total mercury/methylmercury median concentrations, total mercury/methylmercury volume-weighted mean concentrations, total mercury/methylmercury deposition, methylmercury deposition as a percentage of total mercury deposition, and total mercury/methylmercury deposition per inch of precipitation.

FALL 2000 (November 1 through December 26, 2000)

	Huntington	Bloomington	Dunes
Total precipitation (inches)	4.9	0.67	4.5
Total mercury median concentration (nanograms per liter)	5.3	5.6	6.2
Total mercury volume-weighted mean concentration (nanograms per liter)	6.2	8.4	5.9
Total mercury sum of weekly deposition (nanograms per square meter)	772	95	673
Total mercury deposition per inch of precipitation (nanograms per square meter) ^a	157	142	151
Number of samples with wet deposition of total mercury	7	1	8
Methylmercury median concentration (nanograms per liter)	.07	.01	.04
Methylmercury volume-weighted mean concentration (nanograms per liter)	.06	.01	.05
Methylmercury sum of weekly deposition (nanograms per square meter)	7.5	.20	6.0
Methylmercury deposition per inch of precipitation (nanograms per square meter) ^a	1.5	.30	1.3
Number of samples with wet deposition of methylmercury	6	1	7
Ratio of methylmercury deposition to total mercury deposition (percent) ^b	1	0.2	.9
National Atmospheric Deposition Program monitoring station identifier	IN20	IN28	IN34

^aCalculated with non-rounded values, as seasonal sum of weekly deposition divided by seasonal precipitation.

^bRatio of methylmercury deposition to total mercury deposition calculated only for those samples analyzed for both total mercury and methylmercury.

WINTER 2001 (December 26, 2000 through March 27, 2001)

	Huntington	Clifty Falls	Bloomington	Dunes
Total precipitation (inches)	4.1	4.7	4.0	6.0
Total mercury median concentration (nanograms per liter)	8.1	10.2	7.6	11.2
Total mercury volume-weighted mean concentration (nanograms per liter)	9.2	10.7	6.3	9.8
Total mercury sum of weekly deposition (nanograms per square meter)	980	1,240	659	1,511 ^a
Total mercury deposition per inch of precipitation (nanograms per square meter) ^b	237	267	165	253
Number of samples with wet deposition of total mercury	9	11	12	13
Methylmercury median concentration (nanograms per liter)	0.078	0.080	0.059	0.071
Methylmercury volume-weighted mean concentration (nanograms per liter)	0.050	0.069	0.059	0.071
Methylmercury sum of weekly deposition (nanograms per square meter)	5.1	7.6	5.8	10.5
Methylmercury deposition per inch of precipitation (nanograms per square meter) ^b	1.2	1.6	1.4	1.8
Number of samples with wet deposition of methylmercury	6	9	7	9
Ratio of methylmercury deposition to total mercury deposition (percent) ^c	0.52	0.61	0.88	0.70
National Atmospheric Deposition Program monitoring station identifier	IN20	IN21	IN28	IN34

^aIncludes one week with estimated deposition because precipitation data was valid but sample was invalid due to equipment malfunction. Deposition was estimated for this week by use of valid precipitation data and the volume-weighted mean concentration for the valid samples.

^bCalculated with non-rounded values, as seasonal sum of weekly deposition divided by seasonal precipitation.

^cRatio of methylmercury deposition to total mercury deposition calculated only for those samples analyzed for both total mercury and methylmercury.

SPRING 2001 (March 27, 2001 through June 26, 2001)

	Huntington	Clifty Falls	Bloomington	Dunes
Total precipitation (inches)	10.4	7.5	10.0	8.6
Total mercury median concentration (nanograms per liter)	14.9	19.0	15.1	18.9
Total mercury volume-weighted mean concentration (nanograms per liter)	15.1	15.6	14.5	15.1
Total mercury sum of weekly deposition (nanograms per square meter)	4,200	2,974	3,530	3,601 ^a
Total mercury deposition per inch of precipitation (nanograms per square meter) ^b	403	397	354	418
Number of samples with wet deposition of total mercury	12	12	11	12
Methylmercury median concentration (nanograms per liter)	0.050	0.027	0.025	0.057
Methylmercury volume-weighted mean concentration (nanograms per liter)	0.050	0.049	0.028	0.057
Methylmercury sum of weekly deposition (nanograms per square meter)	13.3	9.4	6.8	13.5
Methylmercury deposition per inch of precipitation (nanograms per square meter) ^b	1.3	1.2	0.68	1.6
Number of samples with wet deposition of methylmercury	12	6	10	11
Ratio of methylmercury deposition to total mercury deposition (percent) ^c	0.32	0.32	0.19	0.38
National Atmospheric Deposition Program monitoring station identifier	IN20	IN21	IN28	IN34

^aIncludes two weeks with estimated deposition because precipitation data was valid but sample was invalid due to equipment malfunction. Deposition was estimated for these weeks by use of valid precipitation data and the volume-weighted mean concentration for the valid samples

^bCalculated with non-rounded values, as seasonal sum of weekly deposition divided by seasonal precipitation.

^cRatio of methylmercury deposition to total mercury deposition calculated only for those samples analyzed for both total mercury and methylmercury.

SUMMER 2001 (June 26, 2001 through September 25, 2001)

	Huntington	Clifty Falls	Bloomington	Dunes
Total precipitation (inches)	13.2	12.3	17.2	8.6
Total mercury median concentration (nanograms per liter)	15.0	11.1	11.8	15.3
Total mercury volume-weighted mean concentration (nanograms per liter)	14.9	11.4	12.4	13.8
Total mercury sum of weekly deposition (nanograms per square meter)	5,009	3,575	5,416	3,004
Total mercury deposition per inch of precipitation (nanograms per square meter) ^a	379	292	315	351
Number of samples with wet deposition of total mercury	13	12	10	11
Methylmercury median concentration (nanograms per liter)	0.021	0.031	0.011	0.027
Methylmercury volume-weighted mean concentration (nanograms per liter)	0.041	0.026	0.019	0.033
Methylmercury sum of weekly deposition (nanograms per square meter)	13.8	8.1	8.2	7.3
Methylmercury deposition per inch of precipitation (nanograms per square meter) ^a	1.0	0.66	0.48	0.85
Number of samples with wet deposition of methylmercury	10	7	8	9
Ratio of methylmercury deposition to total mercury deposition (percent) ^b	0.27	0.23	0.15	0.24
National Atmospheric Deposition Program monitoring station identifier	IN20	IN21	IN28	IN34

^aCalculated with non-rounded values, as seasonal sum of weekly deposition divided by seasonal precipitation.

^bRatio of methylmercury deposition to total mercury deposition calculated only for those samples analyzed for both total mercury and methylmercury.

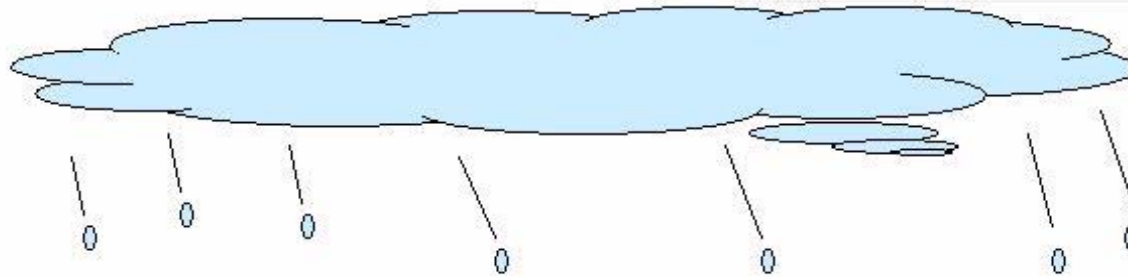
FALL 2001 (September 25, 2001 through December 26, 2001)

	Huntington	Clifty Falls	Bloomington	Dunes
Total precipitation (inches)	12.4	14.9	15.1	12.3
Total mercury median concentration (nanograms per liter)	6.3	8.7	7.3	7.1
Total mercury volume-weighted mean concentration (nanograms per liter)	6.0	11.8	6.1	9.4
Total mercury sum of weekly deposition (nanograms per square meter)	1,890	4,466 ^a	2,347	2,894 ^a
Total mercury deposition per inch of precipitation (nanograms per square meter) ^b	153	300	155	235
Number of samples with wet deposition of total mercury	12	11	12	13
Methylmercury median concentration (nanograms per liter)	0.032	0.017	0.041	0.015
Methylmercury volume-weighted mean concentration (nanograms per liter)	0.039	0.026	0.023	0.021
Methylmercury sum of weekly deposition (nanograms per square meter)	12.3	10.3	8.9	5.8
Methylmercury deposition per inch of precipitation (nanograms per square meter) ^b	0.99	0.69	0.59	0.47
Number of samples with wet deposition of methylmercury	11	9	11	11
Ratio of methylmercury deposition to total mercury deposition (percent) ^c	0.65	0.23	0.25	0.20
National Atmospheric Deposition Program monitoring station identifier	IN20	IN21	IN28	IN34

^aIncludes one week with estimated deposition because precipitation data was valid but sample was invalid due to equipment malfunction. Deposition was estimated for this week by use of valid precipitation data and the volume-weighted mean concentration for the valid samples^bCalculated with non-rounded values, as seasonal sum of weekly deposition divided by seasonal precipitation.

^bCalculated with non-rounded values, as seasonal sum of weekly deposition divided by seasonal precipitation.

^cRatio of methylmercury deposition to total mercury deposition calculated only for those samples analyzed for both total mercury and methylmercury.



Composite Data for 2001

Composite data were calculated for January through December 2001, excluding fall 2000, so that data from all four of the Indiana monitoring stations could be considered. The composite data summary for 2001 in the following table includes annual values for: total mercury/methylmercury median, minimum, and maximum concentrations; total mercury/methylmercury volume-weighted mean concentrations; the sum of total mercury/methylmercury weekly deposition; methylmercury deposition as a percentage of total mercury deposition; and total mercury/methylmercury deposition per inch of precipitation.

A map of Indiana is presented that shows the annual total mercury deposition and total mercury deposition per inch of precipitation at the four Indiana stations in 2001. An illustration is presented that shows box plots of the distributions of the weekly deposition at the four Indiana stations in 2001.

2001 COMPOSITE (December 26, 2000 through December 26, 2001)

	Huntington	Clifty Falls	Bloomington	Dunes
Total precipitation (inches)	40.2	39.3	46.3	35.7
Total mercury median concentration (nanograms per liter)	11.6	11.5	10.8	13.0
Total mercury volume-weighted mean concentration (nanograms per liter)	11.6	12.3	10.3	11.8
Total mercury minimum concentration (nanograms per liter)	2.3	0.08	3.7	2.4
Total mercury maximum concentration (nanograms per liter)	51.2	46.7	27.6	277
Total mercury annual sum of weekly deposition (nanograms per square meter)	12,079	12,555 ^a	11,951	11,051 ^b
Total mercury minimum weekly deposition (nanograms per square meter)	3.6	1.0	1.3	2.2
Total mercury maximum weekly deposition (nanograms per square meter)	1,098	1,703	1,178	1,447
Total mercury deposition per inch of precipitation (nanograms per square meter) ^c	301	312	258	309
Number of samples with wet deposition of total mercury	46	46	45	49
Methylmercury median concentration (nanograms per liter)	0.035	0.032	0.029	0.040
Methylmercury volume-weighted mean concentration (nanograms per liter)	0.044	0.036	0.025	0.040
Methylmercury minimum concentration (nanograms per liter) ^d	< R.L	< R.L	< R.L	0.004
Methylmercury maximum concentration (nanograms per liter)	0.43	0.47	0.87	0.28
Methylmercury annual sum of weekly deposition (nanograms per square meter)	44.6	35.4	29.8	38.0
Methylmercury minimum weekly deposition (nanograms per square meter)	0.084	0.005	0.014	0.001
Methylmercury maximum weekly deposition (nanograms per square meter)	4.8	3.2	3.0	3.3
Methylmercury deposition per inch of precipitation (nanograms per square meter) ^c	1.1	0.9	0.6	1.1
Number of samples with wet deposition of methylmercury	39	31	36	40
Ratio of methylmercury deposition to total mercury deposition (percent) ^e	0.37	0.29	0.25	0.34
National Atmospheric Deposition Program monitoring station identifier	IN20	IN21	IN28	IN34

Footnotes on following page

Footnotes for 2001 Composite Data Summary

^aIncludes one week with estimated deposition because precipitation data was valid but sample was invalid due to equipment malfunction. Deposition was estimated for this week by use of valid precipitation data and the volume-weighted mean concentration for the valid samples.

^bIncludes three weeks with estimated deposition because precipitation data was valid but sample was invalid due to equipment malfunction. Deposition was estimated for these weeks by use of valid precipitation data and the volume-weighted mean concentration for the valid samples.

^cCalculated with non-rounded values, as seasonal sum of weekly deposition divided by seasonal precipitation.

^d<R.L. indicates concentration was less than the reporting limit, which varied from 0.003 to 0.021 nanograms per liter.

^eRatio of methylmercury deposition to total mercury deposition calculated only for those samples analyzed for both total mercury and methylmercury.

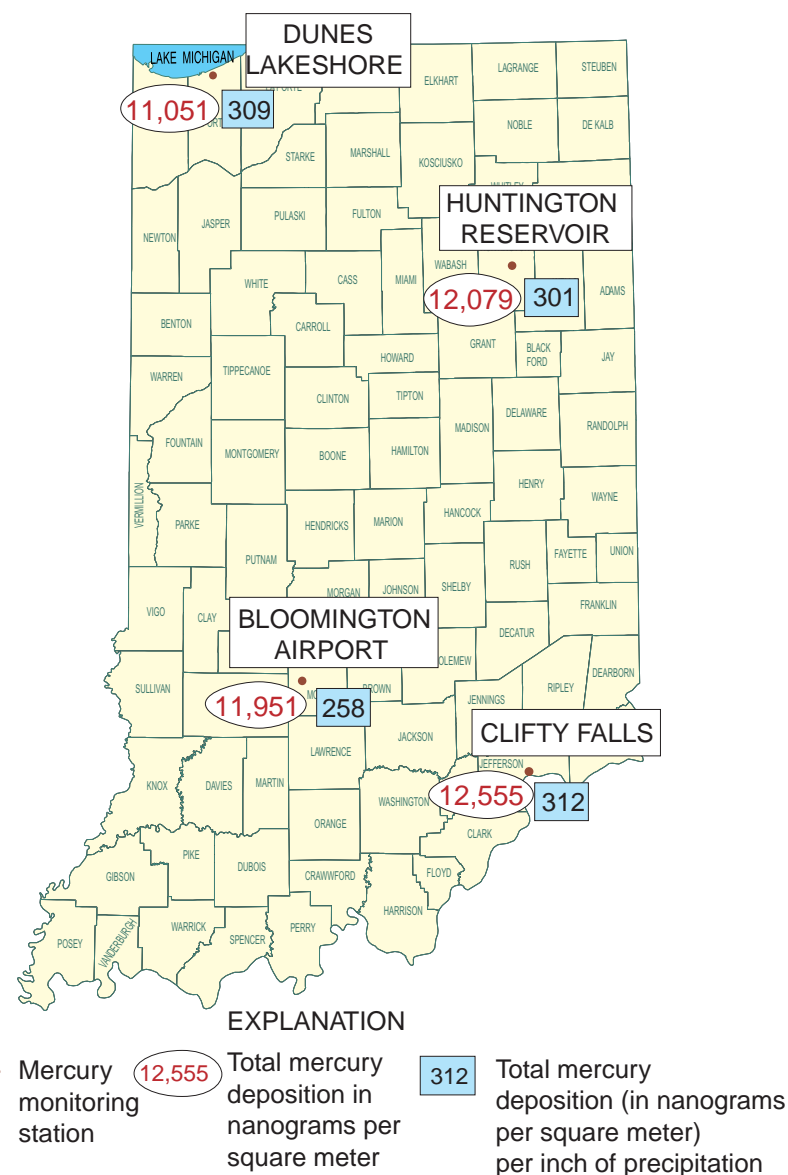
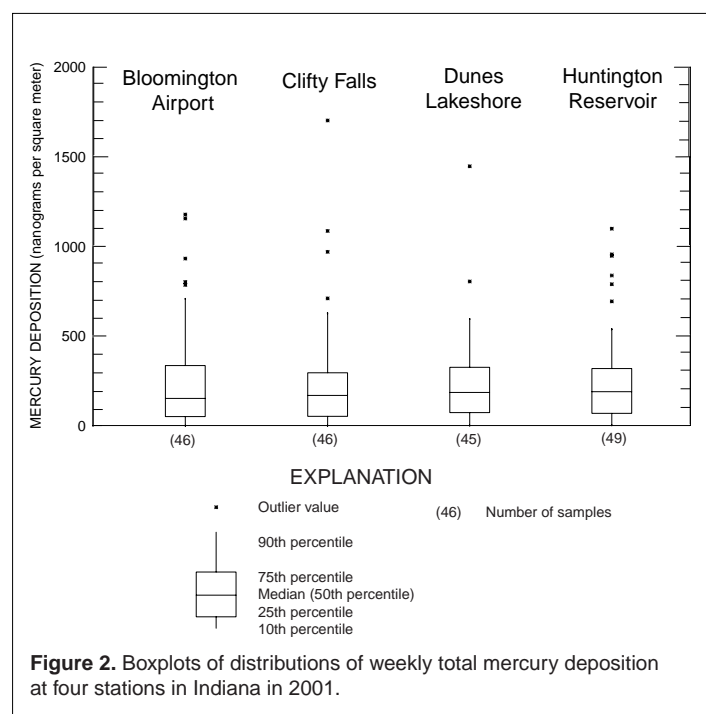
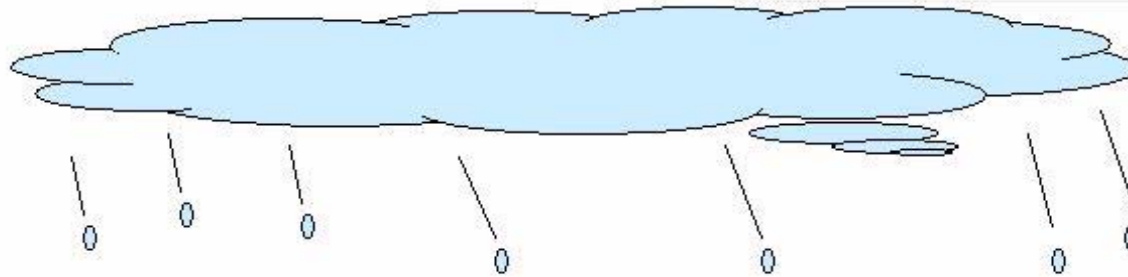


Figure 1. Total mercury deposition in precipitation in 2001 at four monitoring stations in Indiana.



Seasonal Data for 2002

The following three tables present seasonal values for: total mercury/methylmercury median concentrations, total mercury/methylmercury volume-weighted mean concentrations, total mercury/methylmercury deposition, methylmercury deposition as a percentage of total mercury deposition, and total mercury/methylmercury deposition per inch of precipitation. Methylmercury monitoring was discontinued at the end of winter 2002.

After the tables, a chart is presented that shows the seasonal total mercury deposition at the four Indiana stations in winter, spring, summer, and fall 2001 and winter, spring, summer 2002.

WINTER 2002 (December 26, 2001 through March 26, 2002)

	Huntington	Clifty Falls	Bloomington	Dunes
Total precipitation (inches)	7.6	8.5	8.6	5.3
Total mercury median concentration (nanograms per liter)	7.11	9.6	7.9	12.4
Total mercury volume-weighted mean concentration (nanograms per liter)	6.6	12.1	8.3	7.2
Total mercury sum of weekly deposition (nanograms per square meter)	1,356	2,543	1,670 ^a	1,062
Total mercury deposition per inch of precipitation (nanograms per square meter) ^b	178	298	194	200
Number of samples with wet deposition of total mercury	13	13	11	13
Methylmercury median concentration (nanograms per liter)	0.036	0.044	0.046	0.034
Methylmercury volume-weighted mean concentration (nanograms per liter)	0.035	0.044	0.030	0.022
Methylmercury sum of weekly deposition (nanograms per square meter)	7.9 ^c	9.0	8.1	3.4
Methylmercury deposition per inch of precipitation (nanograms per square meter) ^b	1.0	1.0	0.9	0.6
Number of samples with wet deposition of methylmercury	7	12 ^d	10	8
Ratio of methylmercury deposition to total mercury deposition (percent) ^d	0.58	0.35	0.49	0.32
National Atmospheric Deposition Program monitoring station identifier	IN20	IN21	IN28	IN34

^aIncludes one week with estimated deposition because precipitation data was valid but sample was invalid due to equipment malfunction. Deposition was estimated for this week by use of valid precipitation data and the volume-weighted mean concentration for the valid samples.

^bCalculated with non-rounded values, as seasonal sum of weekly deposition divided by seasonal precipitation.

^cIncludes one week with estimated methylmercury deposition because precipitation data was valid and sample volume was adequate but data was invalid due to analytical problems. Methylmercury deposition was estimated for this week by use of valid precipitation data and the volume weighted mean concentration for the valid samples.

^dIncludes two weeks with estimated methylmercury deposition because precipitation data was valid and sample volume was adequate but data was invalid due to analytical problems. Methylmercury deposition was estimated for this week by use of valid precipitation data and the volume weighted mean concentration for the valid samples.

^eRatio of methylmercury deposition to total mercury deposition calculated only for those samples analyzed for both total mercury and methylmercury.

SPRING 2002 (March 26, 2002 through June 25, 2002)

	Huntington	Clifty Falls	Bloomington	Dunes
Total precipitation (inches)	10.7	19.1	19.3	10.7
Total mercury median concentration (nanograms per liter)	16.5	15.2	10.9	21.0
Total mercury volume-weighted mean concentration (nanograms per liter)	15.8	14.3	10.8	16.2
Total mercury sum of weekly deposition (nanograms per square meter)	4,273	6,883	5,253	4,424 ^a
Total mercury deposition per inch of precipitation (nanograms per square meter) ^b	399	360	272	413
Number of samples with wet deposition of total mercury	12	13	12	12
National Atmospheric Deposition Program monitoring station identifier	IN20	IN21	IN28	IN34

^aIncludes one week with estimated deposition because precipitation data was valid but sample was invalid due to equipment malfunction. Deposition was estimated for this week by use of valid precipitation data and the volume-weighted mean concentration for the valid samples.

^bCalculated with non-rounded values, as seasonal sum of weekly deposition divided by seasonal precipitation.

SUMMER 2002 (June 25, 2001 through September 24, 2002)

	Huntington	Clifty Falls	Bloomington	Dunes
Total precipitation (inches)	6.7	7.0	8.6	8.3
Total mercury median concentration (nanograms per liter)	12.4	14.8	11.1	12.2
Total mercury volume-weighted mean concentration (nanograms per liter)	15.1	15.6	16.9	13.9
Total mercury sum of weekly deposition (nanograms per square meter)	2,563	2,637	3,743	2,748
Total mercury deposition per inch of precipitation (nanograms per square meter) ^a	381	377	437	329
Number of samples with wet deposition of total mercury	11	9	8	9
National Atmospheric Deposition Program monitoring station identifier	IN20	IN21	IN28	IN34

^aCalculated with non-rounded values, as seasonal sum of weekly deposition divided by seasonal precipitation.

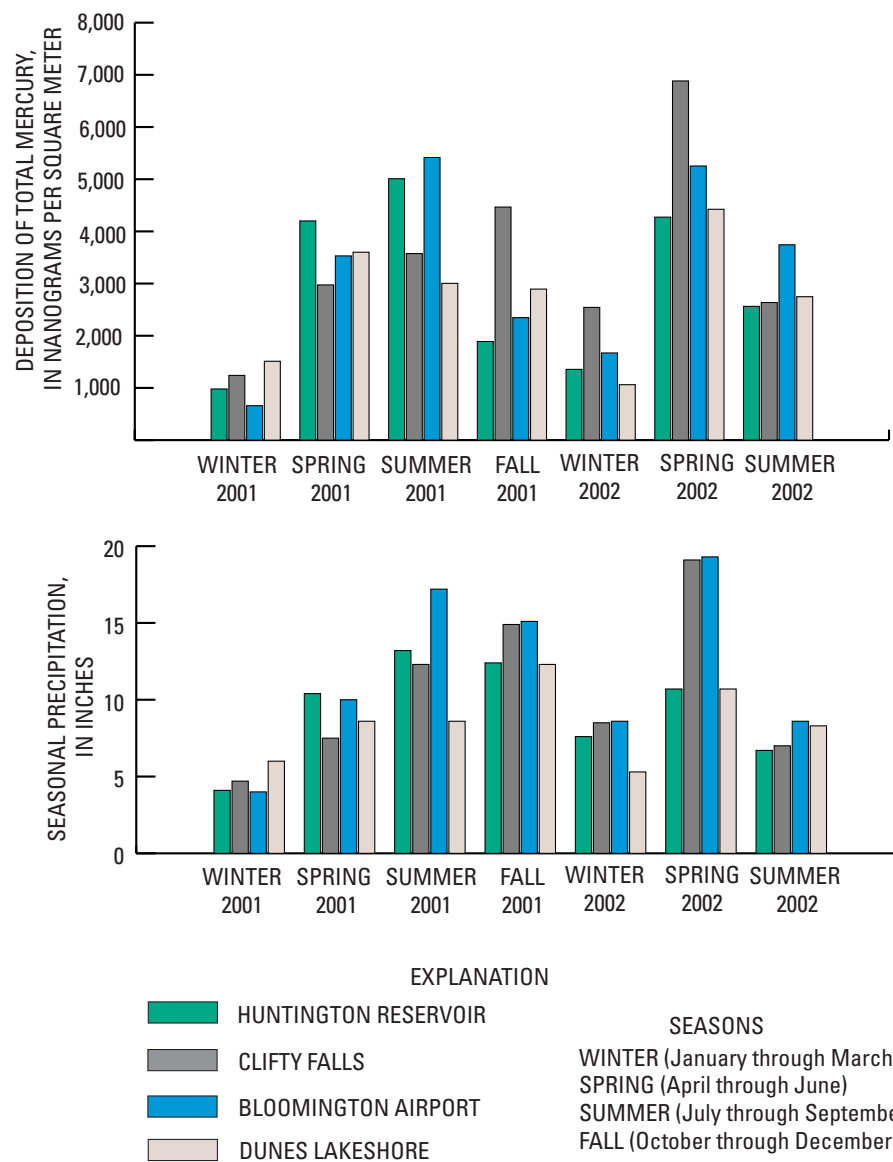


Figure 3. Seasonal deposition of total mercury in precipitation and seasonal precipitation at four monitoring stations in Indiana, January 2001 through September 2002.